

## **DETAILED ACTION**

### ***Status of Claims***

1. Claims 1-14 are current in the application. Claims 1-14 are currently under examination.

### ***Priority***

2. Applicant is advised of possible benefits under 35 U.S.C. 119(a)-(d), wherein an application for patent filed in the United States may be entitled to the benefit of the filing date of a prior application filed in a foreign country.
3. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

### ***Information Disclosure Statement***

4. The information disclosure statement (IDS) submitted on March 15, 2006 was filed on the mailing date of the application on March 15, 2006. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.
5. The Examiner wishes to remind Applicant of the requirements of MPEP § 2001.01, wherein all individuals who are associated with the filing or prosecution of a patent application have a duty to disclose information material to patentability under 37 CFR 1.56.

### ***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:
  - a. The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 1-14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. The term "essentially" in claim 1 is a relative term which renders the claim indefinite. The term "essentially" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. For purposes of compact prosecution, the Examiner will construe the claim as permitting either a closed loop or an open loop reactor.

9. Claim 1, lines 8-9, recites the limitation, "continuously passing the circulating water including the aqueous solution containing the ionic and the cationic species through the ion adsorbing material in the ion adsorption unit while applying an electric potential across the thickness of the layer of ion adsorbing material and removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species." It is unclear whether more material is added to the circulating water. For purposes of compact prosecution, the Examiner will construe this claim limitation as allowing more material to be added to the circulating water.

10. Claim 1, lines 12-13 et seq., recites the limitation, "more concentrated aqueous solutions of the separate ionic species." It is unclear whether this limitation refers to the catholyte in particular, the anolyte in particular, either the catholyte/anolyte, or both the catholyte/anolyte. For purposes of compact prosecution, the Examiner will construe this claim limitation as inclusive of either or both the catholyte/anolyte.

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11. Claim 1, lines 14-15, recites the limitation, "continuously discharging from the ion adsorption unit the more concentrated aqueous solution of one ionic species." It is unclear how this limitation differs from the limitation, "removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species." For purposes of compact prosecution, the Examiner will construe these two claim limitations as equivalent to each other.

12. Claim 1, lines 21, recites the limitation, "continuously recycling eluate." It is unclear whether the ion adsorption unit is continuously loaded, and whether the eluate is the same as the "more concentrated aqueous solution" of lines 14-15.

13. Claim 1 recites the limitation "the layer" in line 11. There is insufficient antecedent basis for this limitation in the claim.

14. Claim 1 recites the limitation "the aqueous solution depleted" in lines 16-17. There is insufficient antecedent basis for this limitation in the claim.

15. Claim 1 recites the limitation "the other ionic species" in lines 18-19. There is insufficient antecedent basis for this limitation in the claim.

16. Claim 1 recites the limitation "the ionic species" in line 19. There is insufficient antecedent basis for this limitation in the claim. It is unclear which ionic species (anion/cation) is being referred to in the claim.

17. Claims 2-9 are rejected as inheriting the lack of clarity and antecedent basis of claim 1.

18. Claim 2 defines the anionic species as ammonium ( $\text{NH}_4^+$ ) and the cationic species as fluoride ( $\text{F}^-$ ). Where applicant acts as his or her own lexicographer to

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specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term “anionic species” in claims 2-9 is used by the claim to mean “(NH<sub>4</sub><sup>+</sup>)”, while the accepted meaning is “a negatively charged ion species.” See e.g. Hawley’s Condensed Chemical Dictionary, 14th ed., John Wiley & Sons © 2002. The term is indefinite because the specification does not clearly redefine the term. The term “cationic species” in claims 2-9 is used by the claim to mean “(F<sup>-</sup>)”, while the accepted meaning is “a positively charged ion species.” The term is indefinite because the specification does not clearly redefine the term. See e.g. Hawley’s Condensed Chemical Dictionary, 14th ed., John Wiley & Sons © 2002. For purposes of compact prosecution, the Examiner will construe the cationic species as ammonium and the anionic species as fluoride, in conformity with the commonly accepted meanings of the terms.

19. Claims 3-9 are rejected as inheriting the improperly redefined terms of claim 2.

20. The term "essentially" in claim 10 is a relative term which renders the claim indefinite. The term "essentially" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. For purposes of compact prosecution, the Examiner will construe the claim as permitting either a closed loop or an open loop reactor.

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21. Claims 11-14 are rejected as inheriting the deficiencies of claim 10.

***Claim Rejections - 35 USC § 103***

22. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

23. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

24. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

25. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Turner et al (US 5,584,981) in view of Bridger et al (US 5,225,056).

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26. Regarding claim 1, Turner et al teaches a method for the treatment of an aqueous stream containing both anionic and cationic species, the method comprising the steps of: continuously circulating water through an essentially closed loop incorporating an ion adsorption unit comprising a water permeable layer of an ion adsorbing material (col. 2, lines 49-50); feeding to the essentially closed loop an aqueous solution containing the anionic and the cationic species (Fig. 2, col. 6, lines 2-4); continuously passing the circulating water including the aqueous solution containing the ionic and the cationic species through the ion adsorbing material in the ion adsorption unit while applying an electric potential across the thickness of the layer of ion adsorbing material and removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species (col. 6, lines 4-12); continuously discharging from the ion adsorption unit the more concentrated aqueous solution of one ionic species (col. 6, lines 11-15); continuously discharging from the ion adsorption unit the aqueous solution depleted in anionic and cationic species (col. 6, lines 4-9).

27. Turner does not explicitly teach continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material, continuously recycling eluate from the reaction unit to the ion adsorption unit; and, if necessary, adding to the closed loop a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit.

28. Bridger teaches continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-

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insoluble solid material (where the Examiner is construing the ion exchange cell as the reaction unit) (col. 3, lines 15-24); continuously recycling eluate from the reaction unit to the ion adsorption unit (col. 3, lines 25-28); and, if necessary, adding to the closed loop a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit (col. 4, lines 3-5). Bridger teaches that this allows separation of ions in solution whose compounds (e.g. metal ions and metal hydroxides) have different solubilities in solution. (col. 1, lines 25-29)

29. Therefore, it would have been obvious to one with ordinary skill, in the art at the time of the invention, to modify the method of Turner et al by continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material, continuously recycling eluate from the reaction unit to the ion adsorption unit; and, if necessary, adding to the closed loop a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit as taught by Bridger et al, because this would allow separation of ions in solution whose compounds have different solubilities in solution. (see Bridger et al, col. 1, lines 25-29)

30. Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Turner et al (US 5,584,981) in view of Bridger et al (US 5,225,056) as applied to claim 1 above, and further in view of Heit et al (US 3,607,694).

31. Regarding claim 2, Turner et al teaches a method for the treatment of an aqueous stream containing both anionic and cationic species, the method comprising the steps of: continuously circulating water through an essentially closed loop

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incorporating an ion adsorption unit comprising a water permeable layer of an ion adsorbing material (col. 2, lines 49-50); feeding to the essentially closed loop an aqueous solution containing the anionic and the cationic species (Fig. 2, col. 6, lines 2-4); continuously passing the circulating water including the aqueous solution containing the ionic and the cationic species through the ion adsorbing material in the ion adsorption unit while applying an electric potential across the thickness of the layer of ion adsorbing material and removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species (col. 6, lines 4-12); continuously discharging from the ion adsorption unit the more concentrated aqueous solution of one ionic species (col. 6, lines 11-15); continuously discharging from the ion adsorption unit the aqueous solution depleted in anionic and cationic species (col. 6, lines 4-9).

32. Turner does not explicitly teach continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material, continuously recycling eluate from the reaction unit to the ion adsorption unit; and, if necessary, adding to the closed loop a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit.

33. Bridger teaches continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material (where the Examiner is construing the ion exchange cell as the reaction unit) (col. 3, lines 15-24); continuously recycling eluate from the reaction unit to the ion adsorption unit (col. 3, lines 25-28); and, if necessary, adding to the closed loop



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a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit (col. 4, lines 3-5). Bridger teaches that this allows separation of ions in solution whose compounds (e.g. metal ions and metal hydroxides) have different solubilities in solution. (col. 1, lines 25-29)

34. Neither Turner et al nor Bridger et al explicitly teach that the cationic species is ammonium and the anionic species is fluoride.

35. Heit et al teaches electrolytically processing a mixture containing cations and halogen anions or halogen anion salts (where the Examiner is construing the halogen anions as comprising fluoride) where the cation may be ammonium. (col. 4, lines 21-27). Heit et al teaches that this allows recovery and regeneration of the halogen acid and its salts. (col. 1, lines 4-6).

36. Therefore, it would have been obvious to one with ordinary skill, in the art at the time of the invention, to modify the method of Turner et al and Bridger et al by using a mixture where the cationic species is ammonium and the anionic species is fluoride as taught by Heit et al, because this would allow recovery and regeneration of the halogen (e.g. fluorine) acid and its ammonium salts. (see Heit et al, col. 1, lines 4-6).

37. Regarding claim 3, Turner et al teaches that a concentrated aqueous ammonium solution is continuously discharged from the ion adsorption unit (where the Examiner is construing the cations emerging as alkaline eluate as the ammonium solution as taught by Heit et al). (col. 6, lines 54-56).

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38. Claims 4-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Turner et al (US 5,584,981) in view of Bridger et al (US 5,225,056) and Heit et al (US 3,607,694) as applied to claim 2 above, and further in view of Kust et al (US 5,403,495).

39. Regarding claim 4, Turner et al teaches a method for the treatment of an aqueous stream containing both anionic and cationic species, the method comprising the steps of: continuously circulating water through an essentially closed loop incorporating an ion adsorption unit comprising a water permeable layer of an ion adsorbing material (col. 2, lines 49-50); feeding to the essentially closed loop an aqueous solution containing the anionic and the cationic species (Fig. 2, col. 6, lines 2-4); continuously passing the circulating water including the aqueous solution containing the ionic and the cationic species through the ion adsorbing material in the ion adsorption unit while applying an electric potential across the thickness of the layer of ion adsorbing material and removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species (col. 6, lines 4-12); continuously discharging from the ion adsorption unit the more concentrated aqueous solution of one ionic species (col. 6, lines 11-15); continuously discharging from the ion adsorption unit the aqueous solution depleted in anionic and cationic species (col. 6, lines 4-9).

40. Turner does not explicitly teach continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material, continuously recycling eluate from the reaction unit to the ion adsorption unit; and, if necessary, adding to the closed loop a

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quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit.

41. Bridger teaches continuously passing the more concentrated solution of the other ionic species through a reaction unit in which the ionic species reacts to form a water-insoluble solid material (where the Examiner is construing the ion exchange cell as the reaction unit) (col. 3, lines 15-24); continuously recycling eluate from the reaction unit to the ion adsorption unit (col. 3, lines 25-28); and, if necessary, adding to the closed loop a quantity of water corresponding to the quantity of aqueous solution removed from the reaction unit (col. 4, lines 3-5). Bridger teaches that this allows separation of ions in solution whose compounds (e.g. metal ions and metal hydroxides) have different solubilities in solution. (col. 1, lines 25-29) Bridger teaches that eluate from the precipitation unit is recycled to the ion adsorption unit to combine with the concentrated ion solution (where the Examiner is construing the eluate from the precipitation unit as fluoride containing and the concentrated fluoride solution as fluoride-containing). (Fig. 1, arrows b, col. 3, lines 25-31)

42. Neither Turner et al nor Bridger et al explicitly teach that the cationic species is ammonium and the anionic species is fluoride.

43. Heit et al teaches electrolytically processing a mixture containing cations and halogen anions or halogen anion salts (where the Examiner is construing the halogen anions as comprising fluoride) where the cation may be ammonium. (col. 4, lines 21-27). Heit et al teaches that this allows recovery and regeneration of the halogen acid and its salts. (col. 1, lines 4-6).

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44. Neither Turner et al, Bridger et al, nor Heit et al teach that a concentrated aqueous fluoride solution is continuously passed from the ion adsorption unit into a calcium precipitation unit thereby to form  $\text{CaF}_2$ .

45. Kust et al teaches passing an aqueous fluoride solution into a calcium precipitation unit thereby to form  $\text{CaF}_2$ . (col. 2, lines 45-49). Kust et al teaches that this may allow improved settling of the calcium fluoride product. (col. 6, lines 12-26)

46. Therefore, it would have been obvious to one with ordinary skill, in the art at the time of the invention, to modify the method of Turner et al, Bridger et al, and Heit et al by passing the concentrated aqueous fluoride solution into a calcium precipitation unit to form  $\text{CaF}_2$  as taught by Kust et al, because this would allow improved settling of the calcium fluoride product. (see Kust et al, col. 6, lines 12-26)

47. Regarding claim 5, Kust et al teaches that a source of calcium as a solution or slurry is continuously admitted to the calcium precipitation unit. (col. 4, lines 24-38).

48. Regarding claim 6, Kust et al teaches that the source of calcium is a slurry of calcium carbonate or of calcium hydroxide. (col. 3, lines 64-68)

49. Regarding claim 7, Kust teaches that depleted aqueous solution continuously discharged from the ion adsorption unit may be used to prepare the solution or slurry of calcium. (Fig. 1, parts 17 and 18, col. 5, lines 1-5)

50. Regarding claim 8, Kust et al teaches that eluate from the calcium precipitation unit is used to prepare the solution or slurry of calcium. (Fig. 1, part 15, col. 5, lines 5-7)

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51. Regarding claim 9, Kust et al teaches that the amount of calcium admitted to the calcium precipitation unit may be less than the stoichiometric amount for capturing fluoride (col. 6, lines 37-40)

52. Claims 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Turner et al (US 5,584,981) in view of Bridger et al (US 5,225,056), and Kuwata et al (US 6,274,019 B1) and further in view of Kust et al (US 5,403,495).

53. Regarding claim 10, Turner et al teaches an apparatus for use in treating an aqueous stream containing both anionic and cationic species, the apparatus comprising: an essentially closed loop circulation system containing (i) an ion adsorption unit comprising a water permeable zone of an ion adsorbing material (Fig. 2, parts 14 and 34, col. 5, lines 50-59) and means for enabling an electrical potential to be applied across the thickness of that zone (Fig. 2, parts 36 and 13, col. 5, lines 50-59) and (ii) a reaction unit in which one of the anionic and cationic species is rendered substantially insoluble (Fig. 2, part 37, col. 5, lines 50-63); an inlet for an aqueous solution containing anionic and cationic species to the closed loop circulation system (Fig. 2, part 33, col. 5, lines 61-62); an outlet for concentrated aqueous solution of one ionic species from the ion adsorption unit (Fig. 2, parts 19, col. 6, lines 11-15); and an outlet for depleted aqueous solution from the ion adsorption unit (Fig. 2, part 35, col. 5, lines 61-62).

54. Turner et al does not explicitly teach a pump for continuously circulating aqueous solution around the closed loop.

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55. Bridger et al teaches a pump for continuously circulating aqueous solution around the closed loop (Fig. 1, part 4, col. 3, line 9). Bridger teaches that this allows desired pH values for the reaction to be reached by recirculating the electrolyte through the cell. (col. 2, lines 23-24).

56. Neither Turner et al nor Bridger et al explicitly teach an outlet for solid from the reaction unit.

57. Kust et al teaches an outlet for solids from the reaction unit. (Fig. 1, parts 30 and 34, col. 5, lines 8-15). Kust et al teaches that this allows removal and recycling of the solids for industrial uses. (col. 2, lines 21-25)

58. Neither Turner et al, Bridger et al, nor Kust et al teach an inlet for water into the closed loop circulation system.

59. Kuwata et al teaches an electrodeionization apparatus with an inlet for water into the closed loop circulation system. (Fig. 1, Make-up water, col. 4, lines 5-15). Kuwata et al teaches that this prevents scales from forming in the concentrate chambers or electrode chambers. (col. 2, lines 52-54)

60. Therefore, it would have been obvious to one with ordinary skill, in the art at the time of the invention, to modify the apparatus of Turner et al by adding a pump for continuously circulating aqueous solution around the closed loop as taught by Bridger et al, because this would allow desired pH values for the reaction to be reached by recirculating the electrolyte through the cell (see Bridger, col. 2, lines 23-24); providing an outlet for solids from the reaction unit as taught by Kust et al, because this would allow removal and recycling of the solids for industrial uses (see Kust et al, col. 2, lines

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21-25); and providing an inlet for water into the closed loop circulation system as taught by Kuwata et al, because this would prevent scales from forming in the concentrate chambers or electrode chambers. (see Kuwata et al, col. 2, lines 52-54)

61. Regarding claim 11, Kust et al teaches that the reaction unit is a calcium fluoride precipitation unit (Fig. 1, parts 10, 20 and 30, col. 4, lines 29-33 and col. 5, lines 8-15) which comprises an inlet for an aqueous solution or slurry of a calcium source (Fig. 1, part 12, col. 4, lines 34-38), an inlet for concentrated aqueous fluoride solution (Fig. 1, part 18, col. 4, lines 47-53), an outlet for calcium fluoride (Fig. 1, part 34, col. 5, lines 8-15) and an outlet for aqueous fluoride eluate (Fig. 1, part 15, lines 8-15).

62. Regarding claim 12, Kust et al teaches that the inlet for the aqueous solution or slurry of the calcium source is operatively connected to a mixing vessel in which the calcium source is mixed with water. (col. 7, lines 26-29)

63. Regarding claim 13, Kust et al teaches that the mixing vessel is operatively connected to the outlet for depleted aqueous solution from the ion adsorption unit (where the Examiner is construing the pretreatment reactor of Kust as connected to the outlet for depleted aqueous solution from the ion adsorption unit of Turner and/or Bridger). (Fig. 1, parts 10, 12, 14, and 16, col. 5, lines 64-66)

64. Regarding claim 14, Kust et al teaches that the mixing vessel is operatively connected to the outlet for aqueous fluoride eluate from the calcium fluoride precipitation unit (where the Examiner is construing the waste water inlet of Kust as connected to the outlet for depleted aqueous solution from the ion adsorption unit of Turner and/or Bridger). (Fig. 1, part 18, col. 4, lines 47-53)

***Conclusion***

65. Claims 1-14 are REJECTED.

66. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US Pat. Pub. 2006/0101995 A1 (Treatment of chemical waste); US 4,871,431 (Apparatus for the removal of dissolved solids from liquids using bipolar membranes); US 4,969,983 (Apparatus and process for the removal of acidic and basic gases from fluid mixtures using bipolar membranes); US 5,215,632 (Fluoride removal from aqueous streams); US 6,613,230 B2 (Method for simultaneous removal of arsenic and fluoride from aqueous solutions); US 6,652,758 B2 (Simultaneous ammonia and fluoride treatment for wastewater).

67. Any inquiry concerning this communication or earlier communications from the examiner should be directed to COLLEEN M. RAPHAEL whose telephone number is (571)270-5991. The examiner can normally be reached on Monday-Friday, 9:30 a.m. to 6:00 p.m.

68. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Keith D. Hendricks can be reached on (571)272-1401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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69. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C. M. R./  
Examiner, Art Unit 1724  
April 9, 2011

/Keith D. Hendricks/  
Supervisory Patent Examiner, Art Unit 1724